Fig. 1

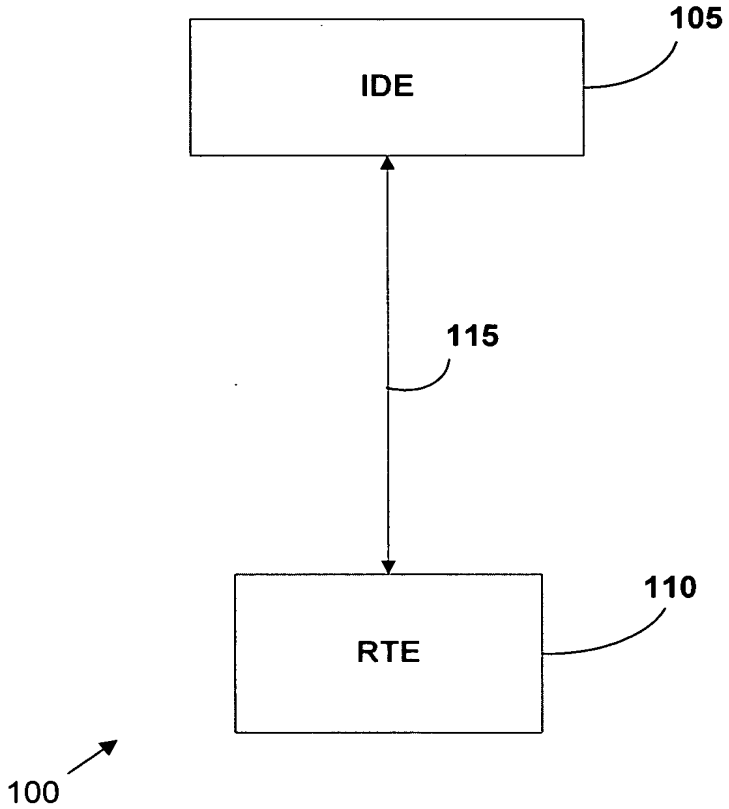


FIG. 2

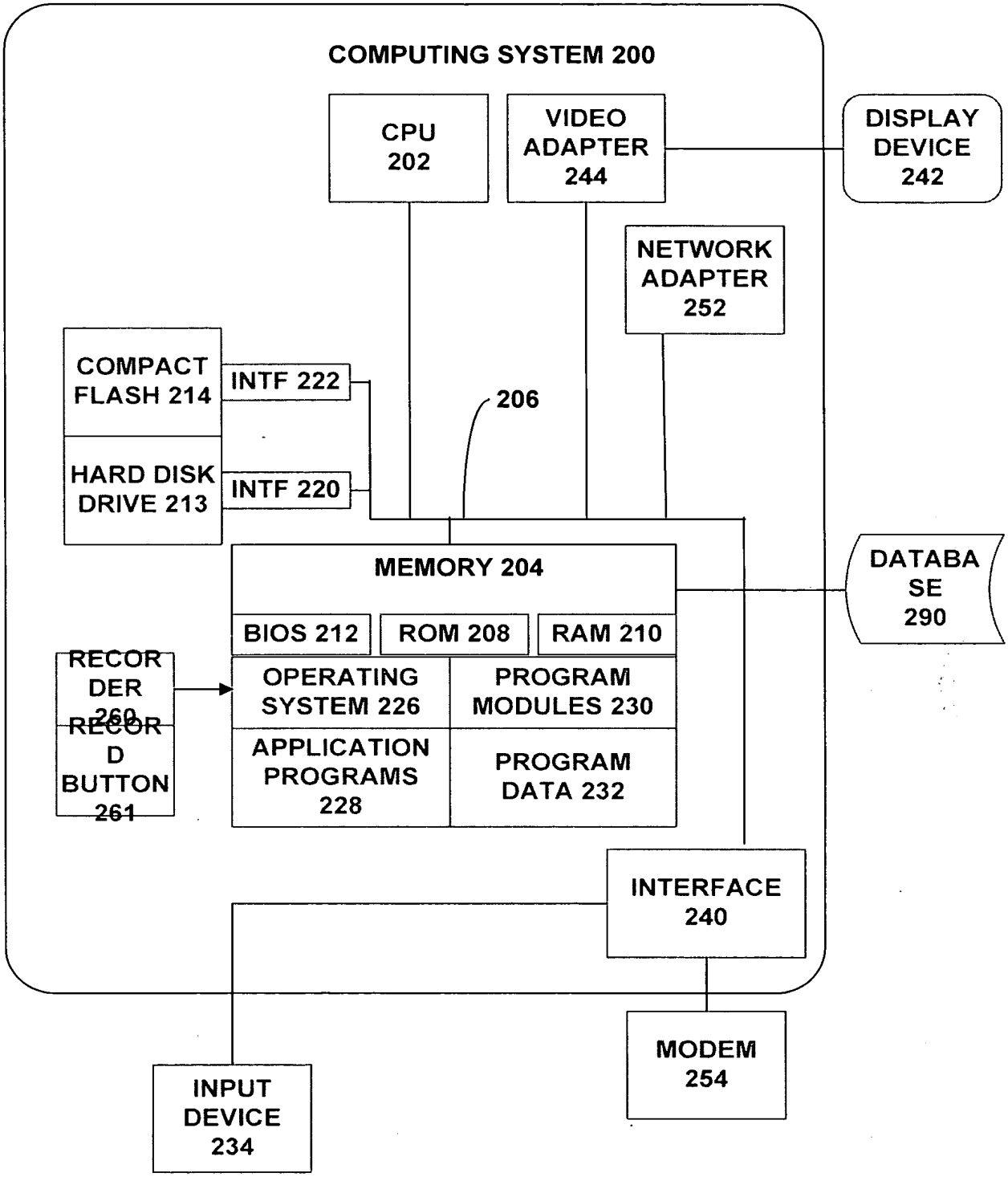

COMPUTING SYSTEM 200
CPU 202
VIDEO ADAPTER 244
DISPLAY DEVICE 242
NETWORK ADAPTER 252
COMPACT FLASH 214
INTF 222
206
HARD DISK DRIVE 213
INTF 220
MEMORY 204
DATABASE 290
BIOS 212
ROM 208
RAM 210
RECORDER 260
RECORD BUTTON 261
OPERATING SYSTEM 226
PROGRAM MODULES 230
APPLICATION PROGRAMS 228
PROGRAM DATA 232
INTERFACE 240
MODEM 254
INPUT DEVICE 234

FIG. 3

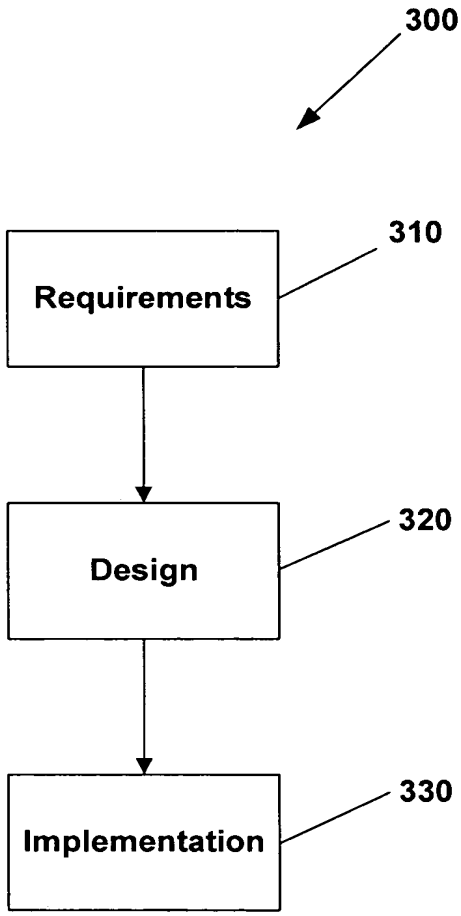


FIG. 4

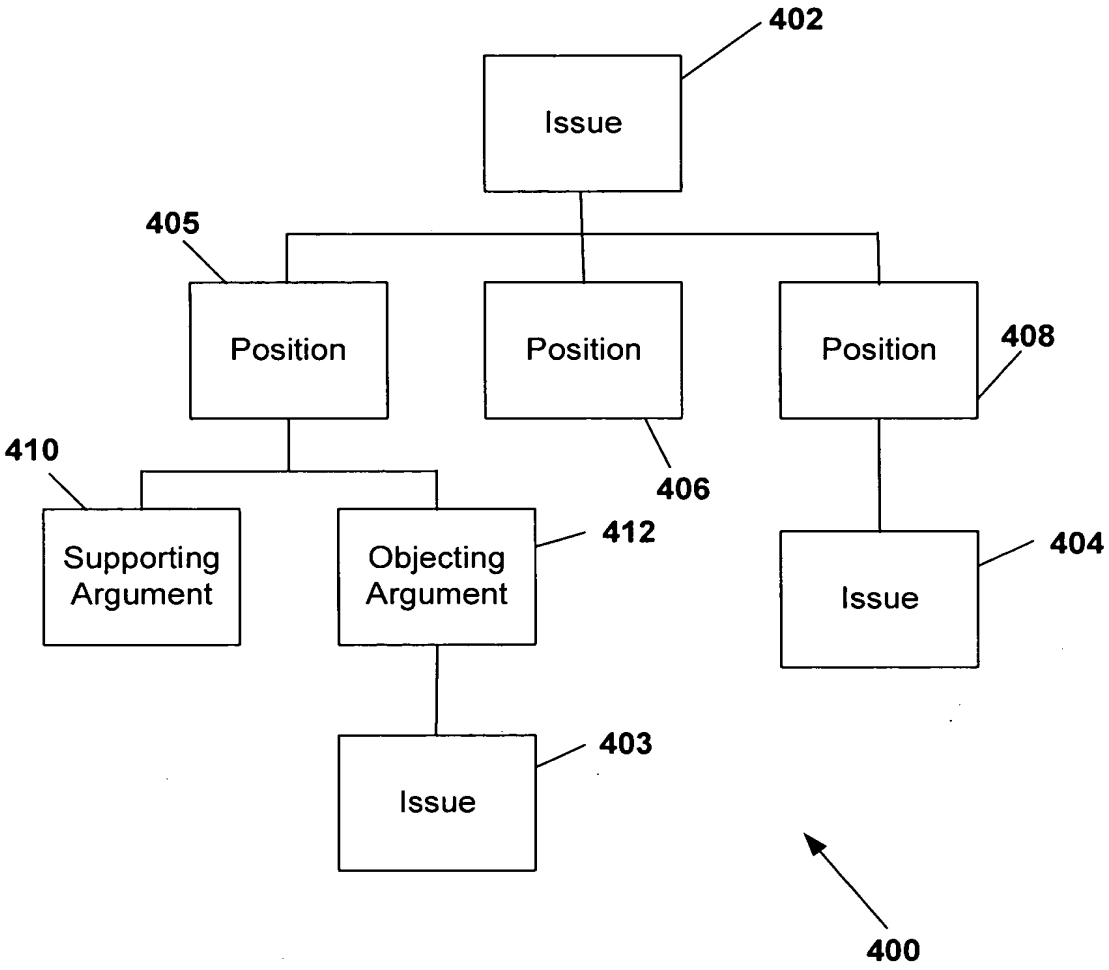

402
Issue
405
Position
Position
Position
408
410
406
Supporting Argument
Objecting Argument
412
404
Issue
403
Issue
400

FIG. 5

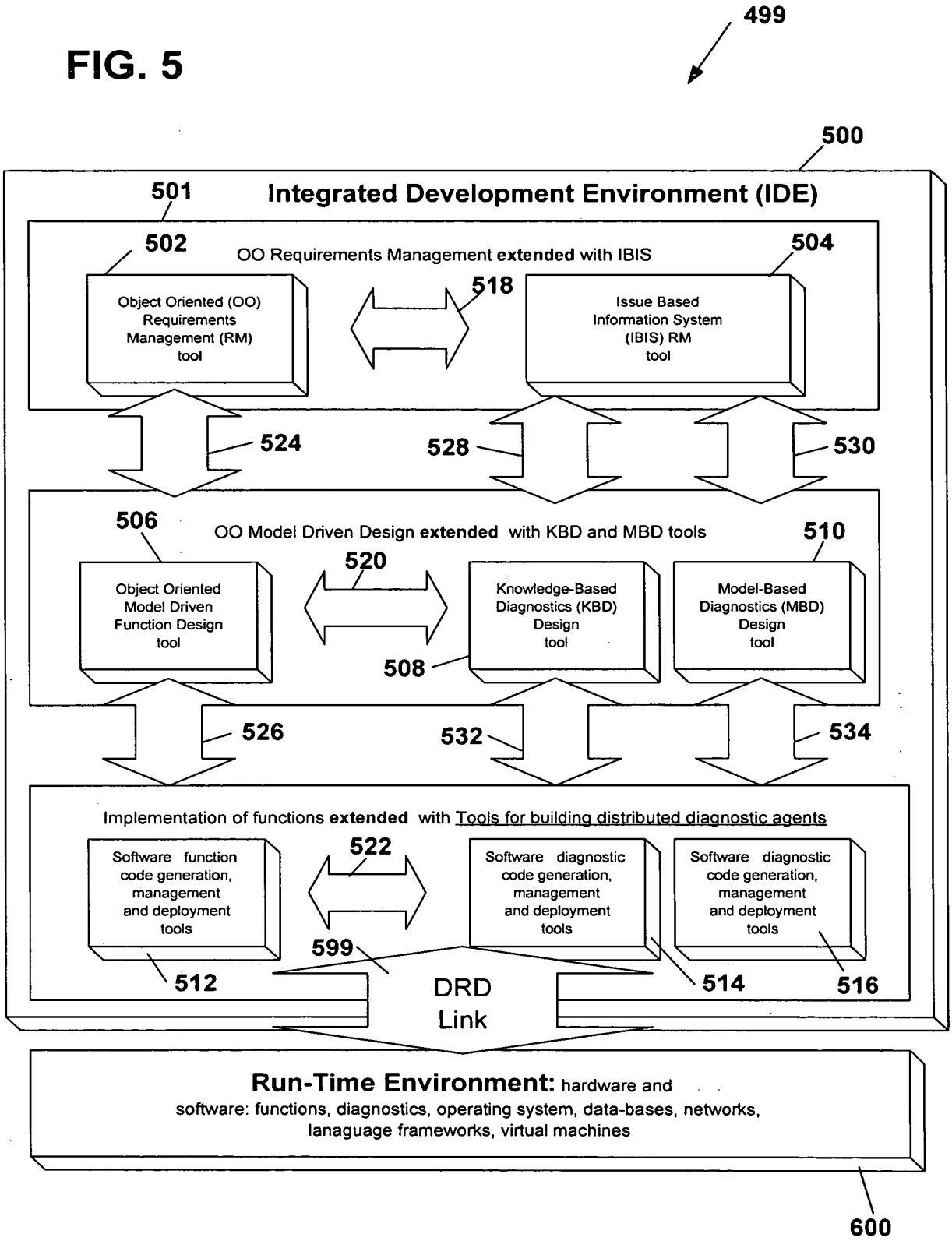

499
500
501
Integrated Development Environment (IDE)
502
OO Requirements Management extended with IBIS
504
Object Oriented (OO) Requirements Management (RM) tool
518
Issue Based Information System (IBIS) RM tool
524
528
530
506
OO Model Driven Design extended with KBD and MBD tools
510
520
Object Oriented Model Driven Function Design tool
Knowledge-Based Diagnostics (KBD) Design tool
Model-Based Diagnostics (MBD) Design tool
508
526
532
534
Implementation of functions extended with Tools for building distributed diagnostic agents
522
Software function code generation, management and deployment tools
Software diagnostic code generation, management and deployment tools
Software diagnostic code generation, management and deployment tools
599
512
514
516
DRD Link
Run-Time Environment: hardware and software: functions, diagnostics, operating system, data-bases, networks, lanaguage frameworks, virtual machines
600

FIG. 6

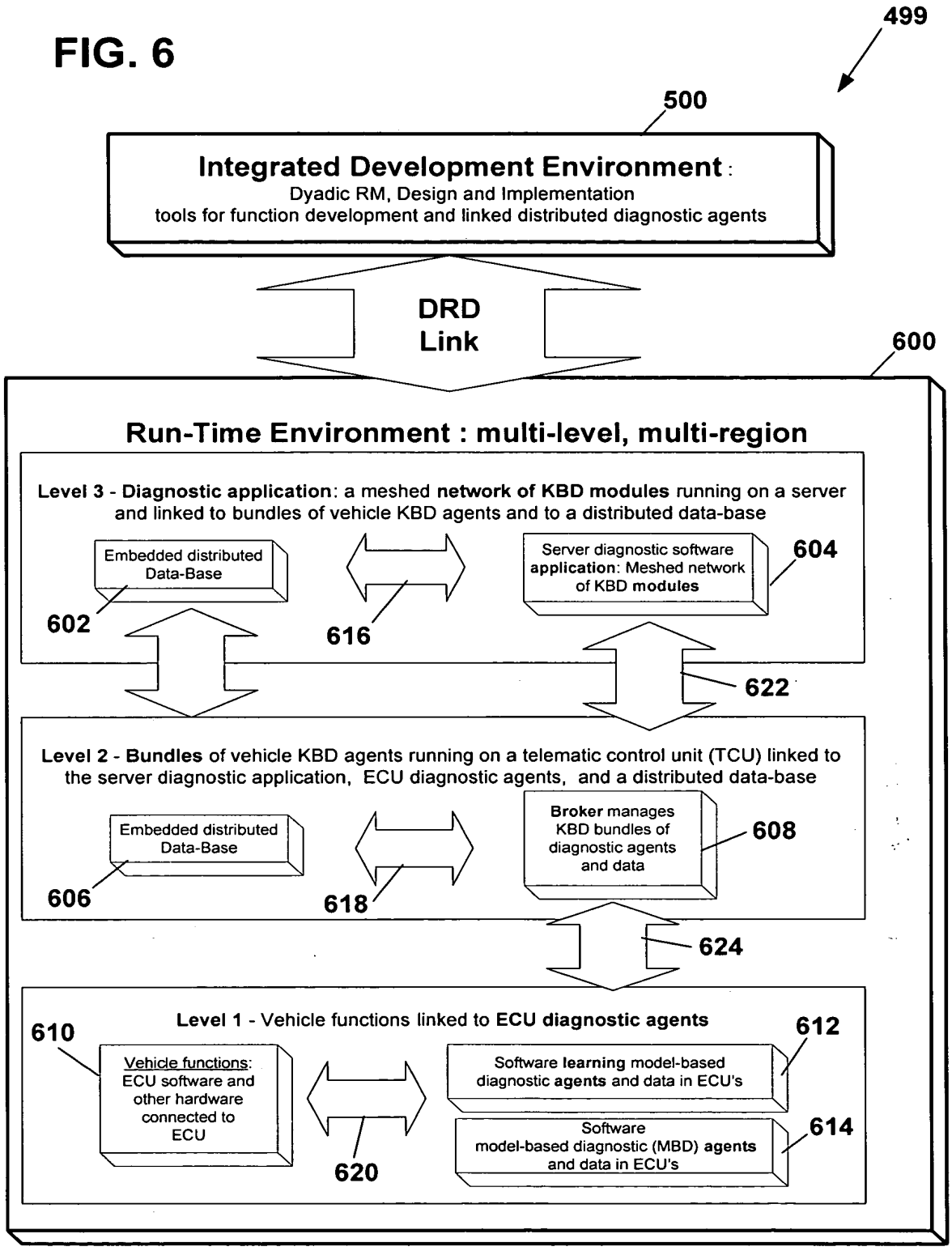

499
500
Integrated Development Environment :
Dyadic RM, Design and Implementation
tools for function development and linked distributed diagnostic agents
DRD
Link
600
Run-Time Environment : multi-level, multi-region
Level 3 - Diagnostic application: a meshed network of KBD modules running on a server and linked to bundles of vehicle KBD agents and to a distributed data-base
Embedded distributed Data-Base
602
616
Server diagnostic software application: Meshed network of KBD modules
604
622
Level 2 - Bundles of vehicle KBD agents running on a telematic control unit (TCU) linked to the server diagnostic application, ECU diagnostic agents, and a distributed data-base
Embedded distributed Data-Base
606
618
Broker manages KBD bundles of diagnostic agents and data
608
624
Level 1 - Vehicle functions linked to ECU diagnostic agents
610
Vehicle functions: ECU software and other hardware connected to ECU
620
Software learning model-based diagnostic agents and data in ECU's
612
Software model-based diagnostic (MBD) agents and data in ECU's
614

FIG. 7

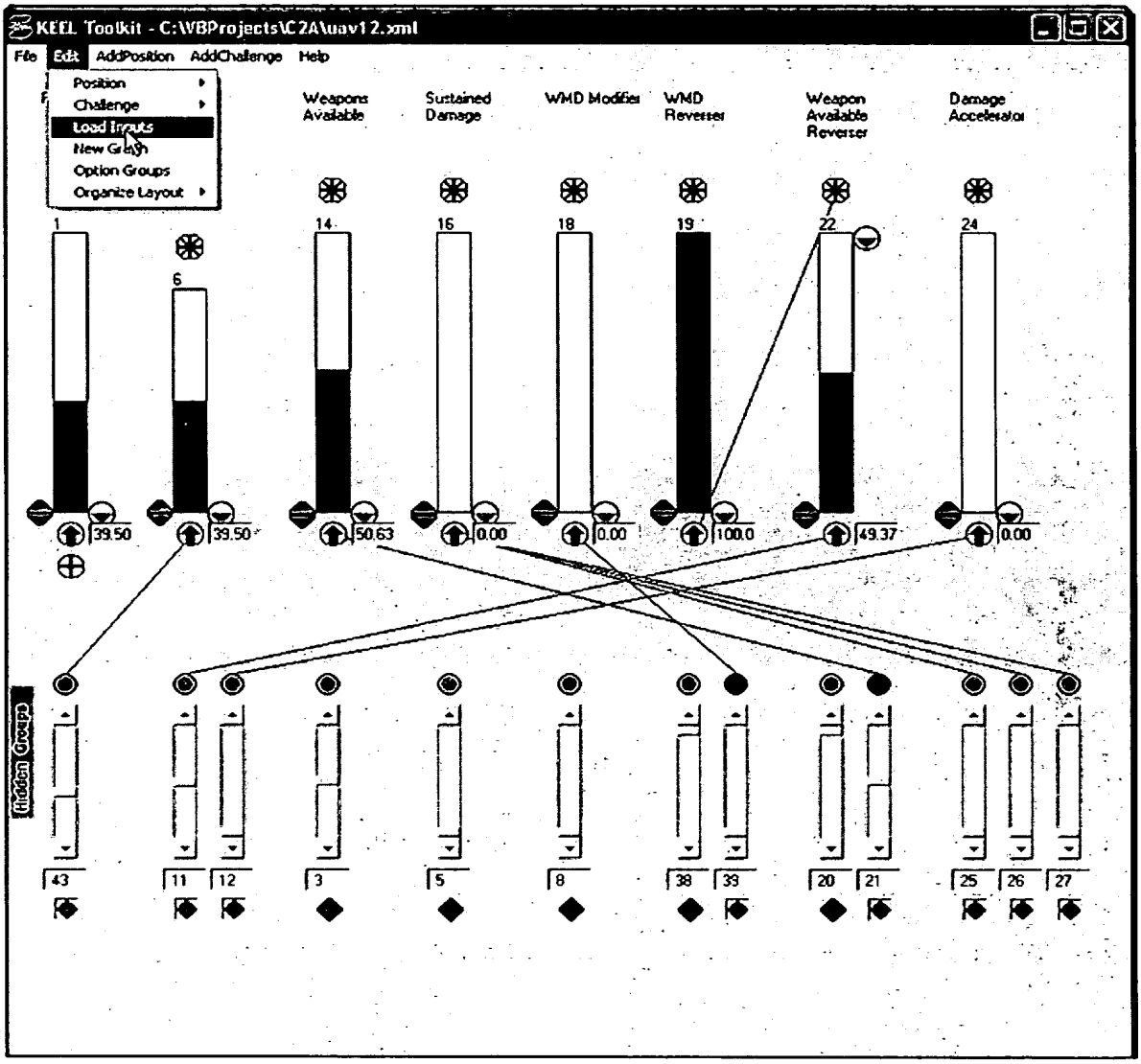

KEEL Toolkit - C:\WBProjects\C2A\uav12.xml
File
Edit
AddPosition
AddChallenge
Help
Position
Challenge
Load Inputs
New Graph
Option Groups
Organize Layout
Weapons Available
Sustained Damage
WMD Modifier
WMD Reverser
Weapon Available Reverser
Damage Accelerator
1
6
14
16
18
19
22
24
39.50
39.50
50.63
0.00
0.00
100.0
49.37
0.00
Hidden Groups
43
11
12
3
5
8
38
39
20
21
25
26
27

FIG. 8

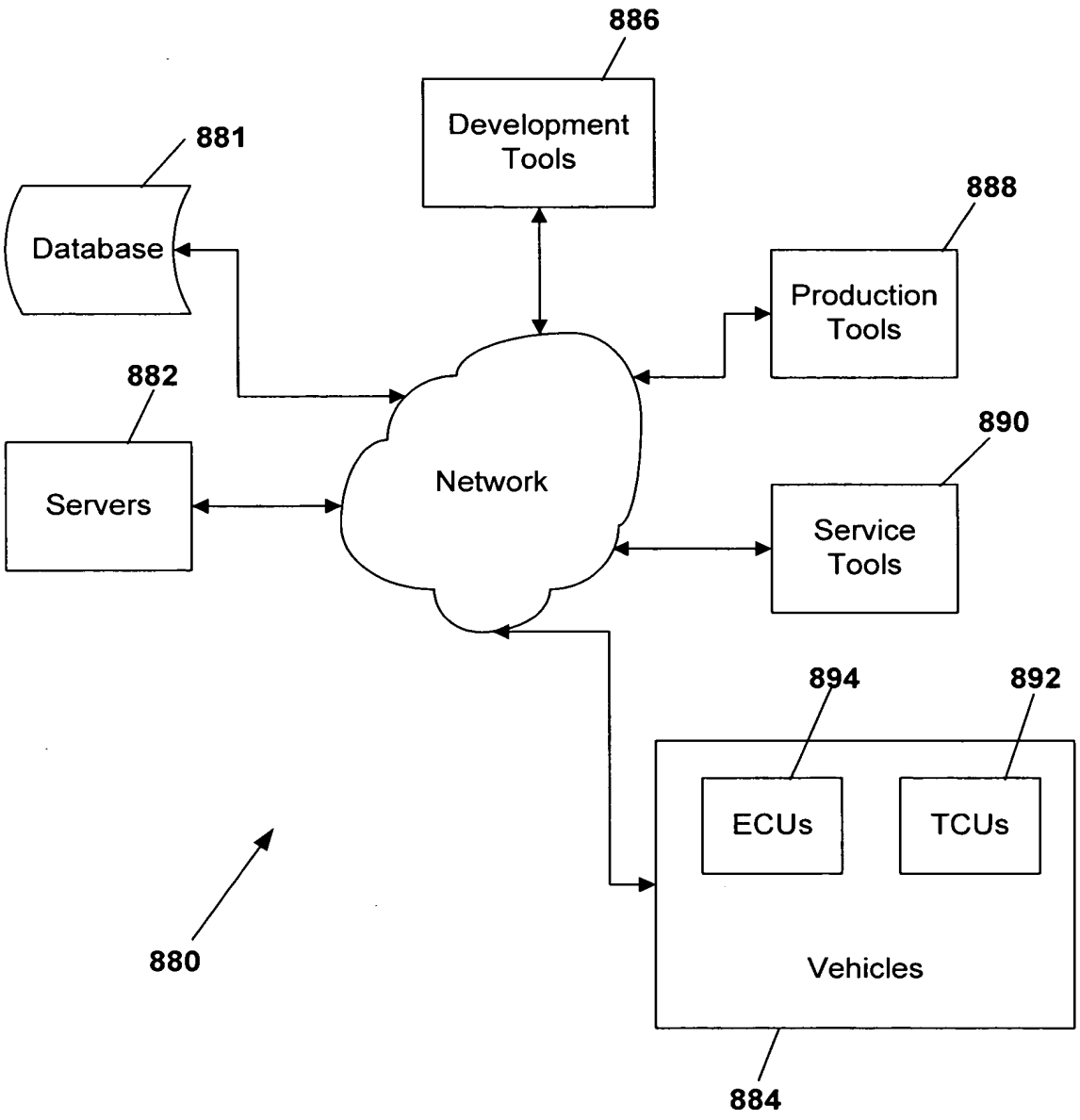

886
Development Tools
881
Database
888
Production Tools
882
Servers
Network
890
Service Tools
894
892
ECUs
TCUs
Vehicles
880
884

FIG. 9

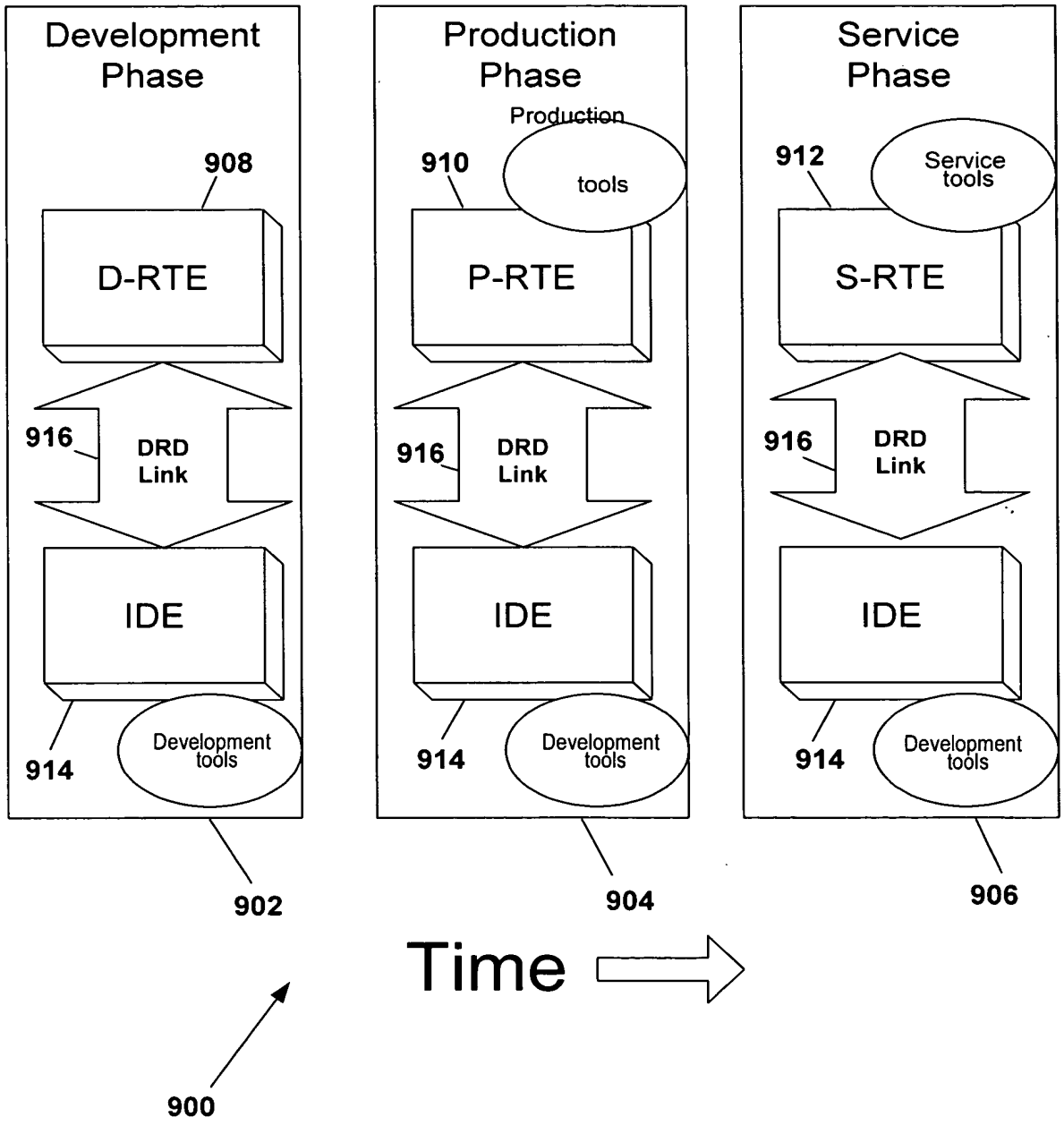

Development Phase
908
D-RTE
916
DRD Link
IDE
914
Development tools
902
Production Phase
Production tools
910
P-RTE
916
DRD Link
IDE
914
Development tools
904
Service Phase
912
Service tools
S-RTE
916
DRD Link
IDE
914
Development tools
906
Time
900

FIG. 10

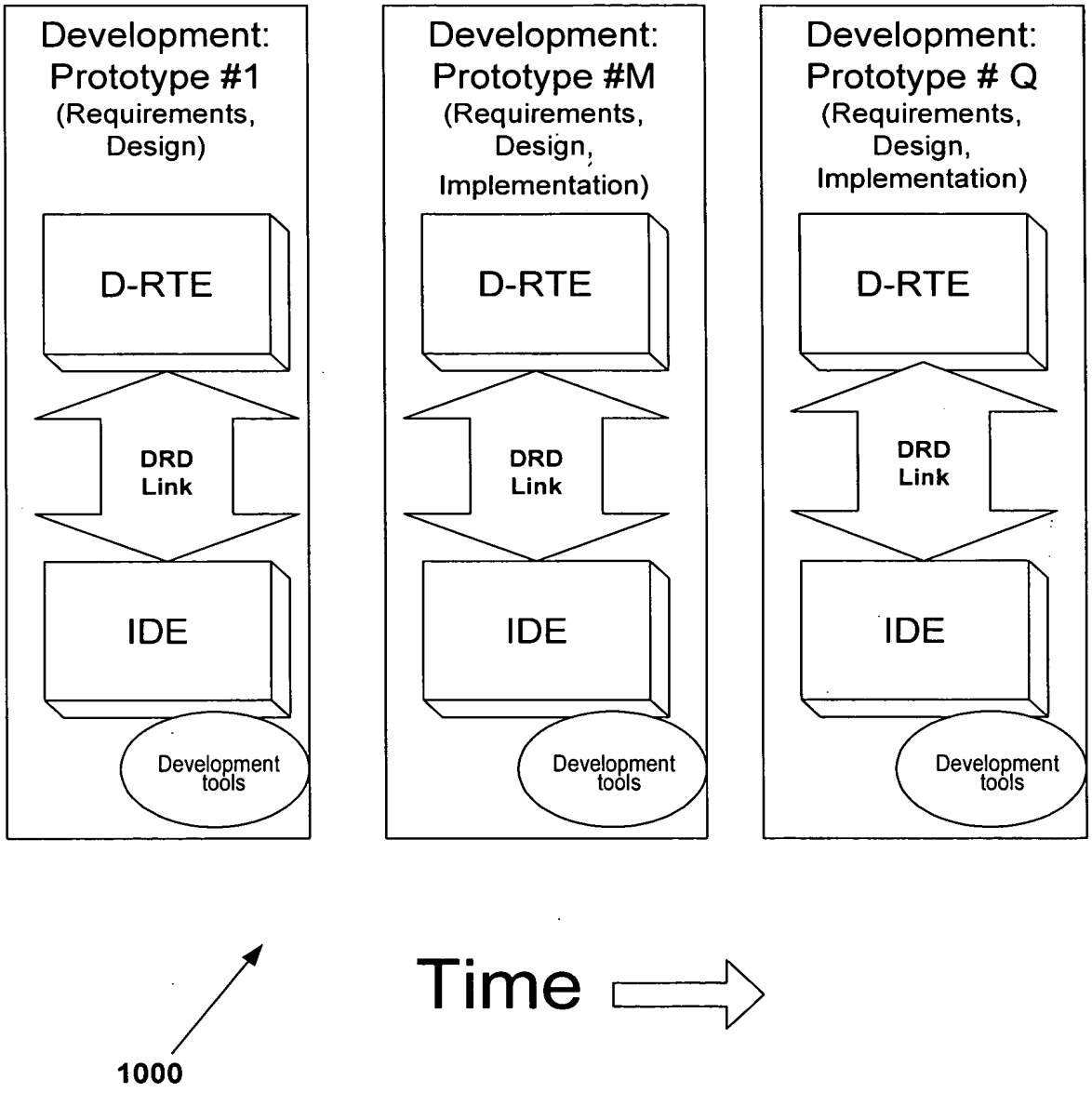

Development: Prototype #1 (Requirements, Design)
D-RTE
DRD Link
IDE
Development tools
Development: Prototype #M (Requirements, Design, Implementation)
D-RTE
DRD Link
IDE
Development tools
Development: Prototype # Q (Requirements, Design, Implementation)
D-RTE
DRD Link
IDE
Development tools
Time
1000

FIG. 11

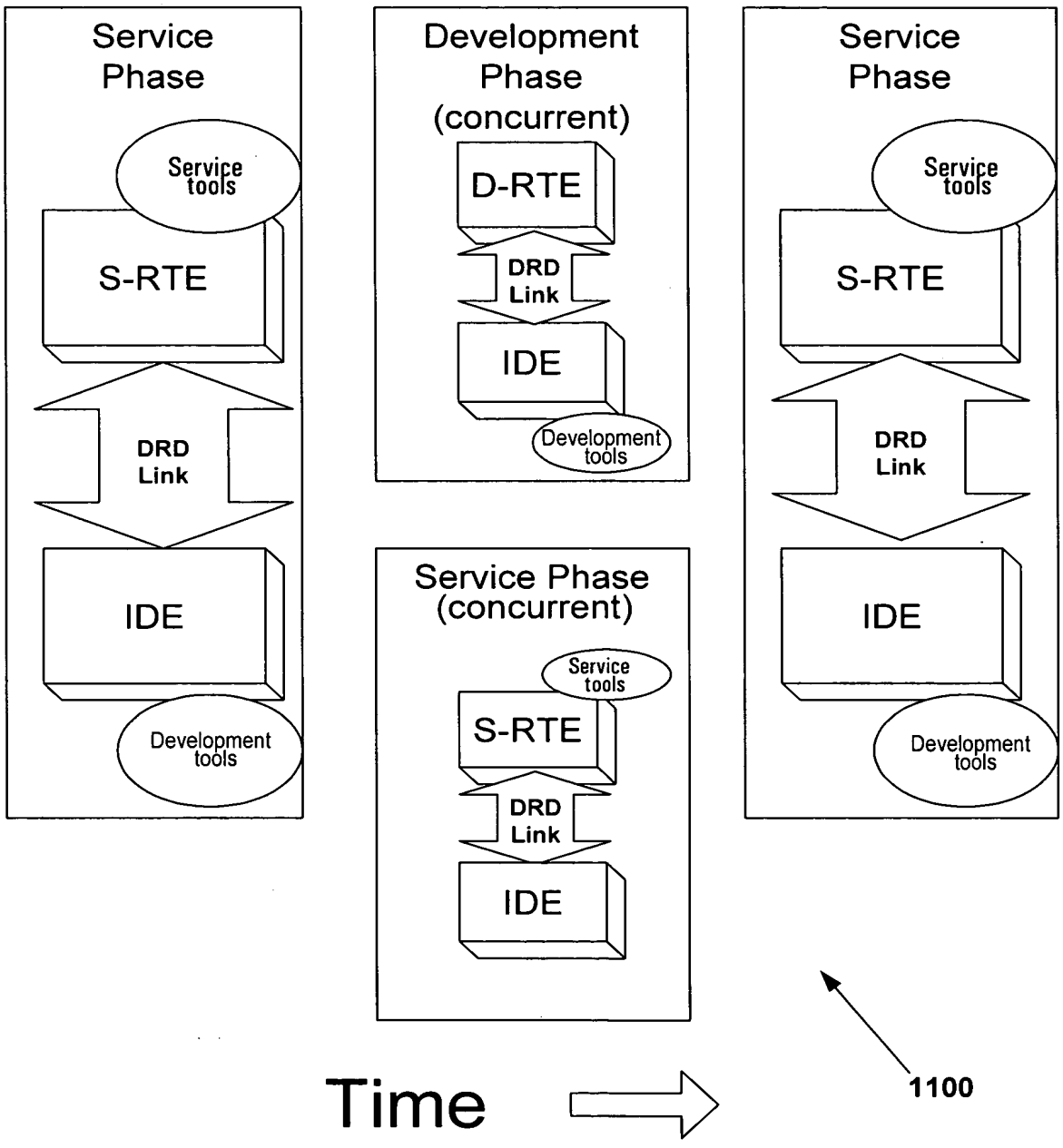

Service Phase
Service tools
S-RTE
DRD Link
IDE
Development tools
Development Phase (concurrent)
D-RTE
DRD Link
IDE
Development tools
Service Phase (concurrent)
Service tools
S-RTE
DRD Link
IDE
Service Phase
Service tools
S-RTE
DRD Link
IDE
Development tools
Time
1100

FIG. 12

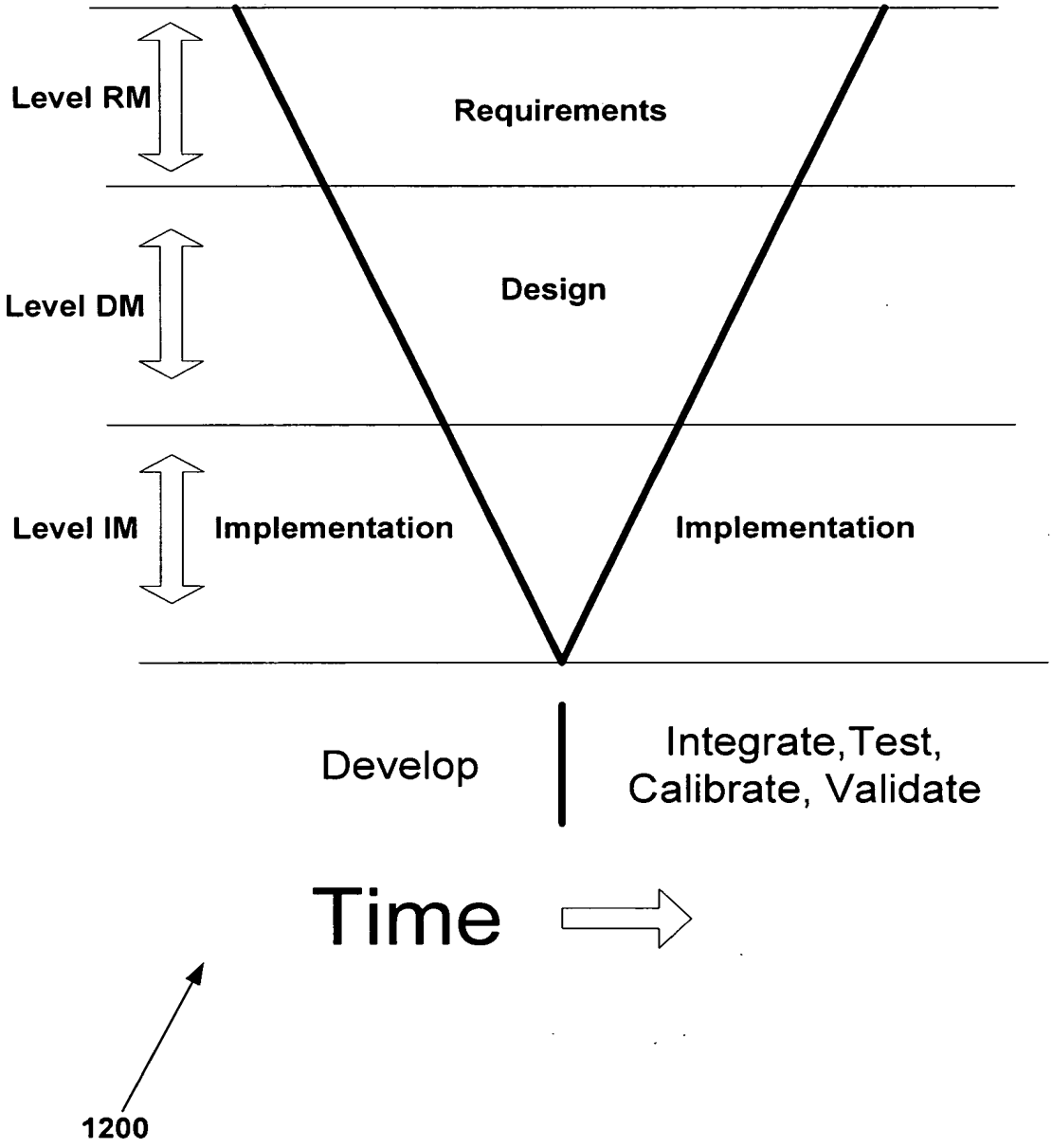

Level RM
Requirements
Level DM
Design
Level IM
Implementation
Implementation
Develop
Integrate, Test,
Calibrate, Validate
Time
1200

FIG. 13

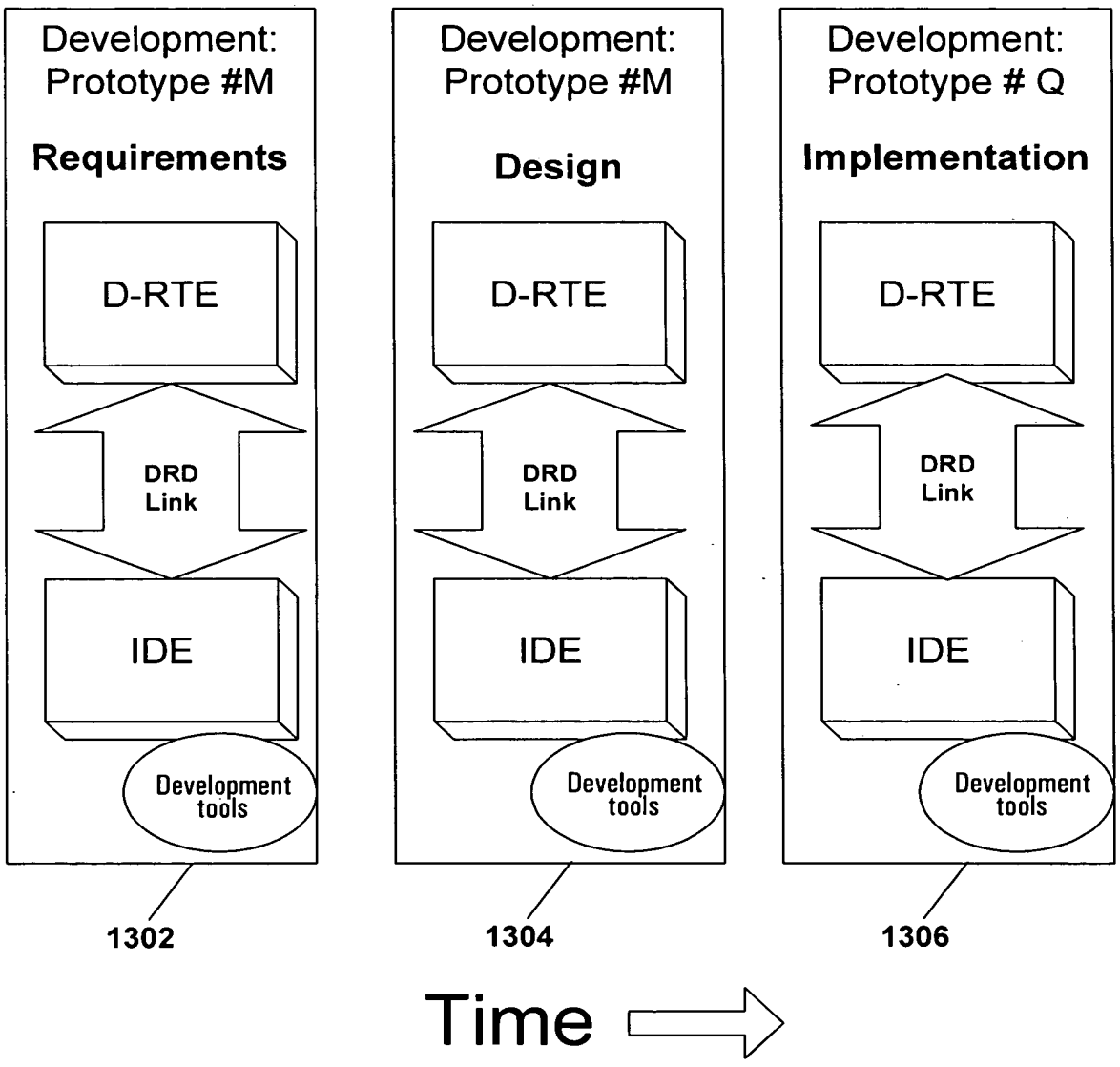

Development: Prototype #M
Requirements
D-RTE
DRD Link
IDE
Development tools
1302
Development: Prototype #M
Design
D-RTE
DRD Link
IDE
Development tools
1304
Development: Prototype # Q
Implementation
D-RTE
DRD Link
IDE
Development tools
1306
Time

FIG. 14

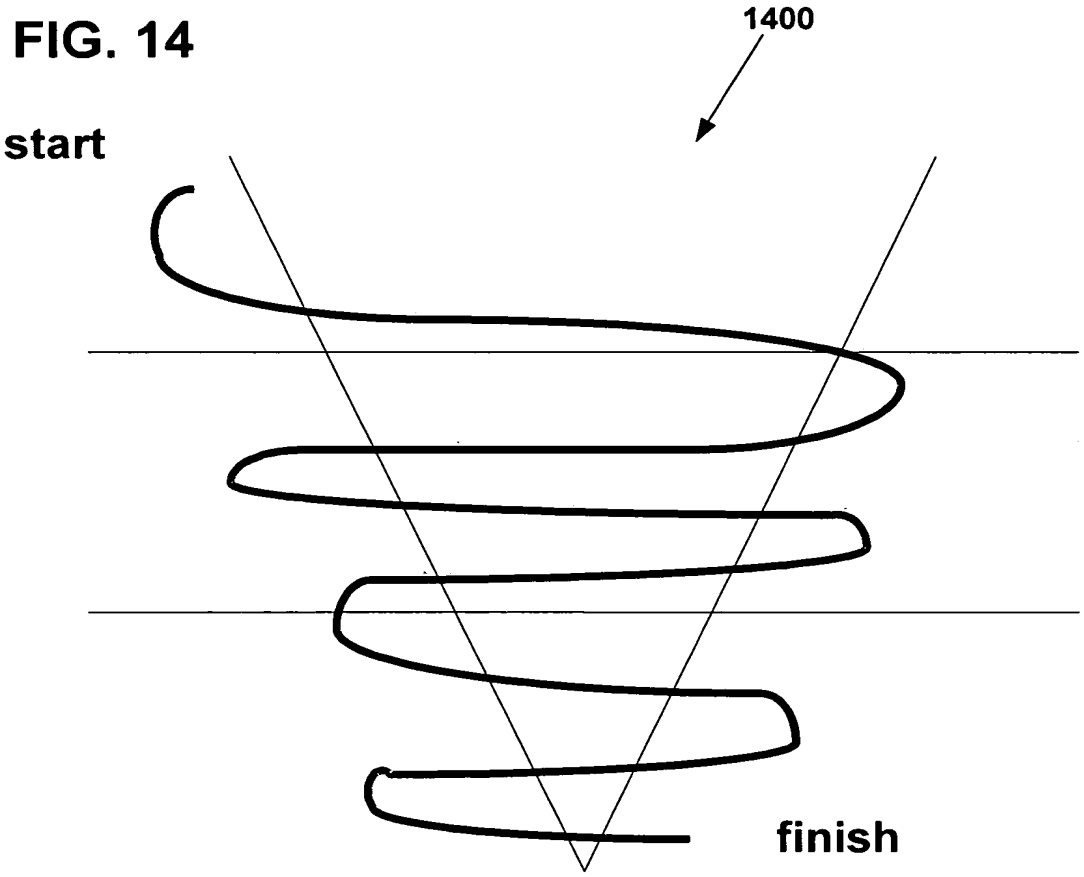

1400
start
finish
Time follows the spiral
Develop
Integrate, Test,
Calibrate, Validate

FIG. 15

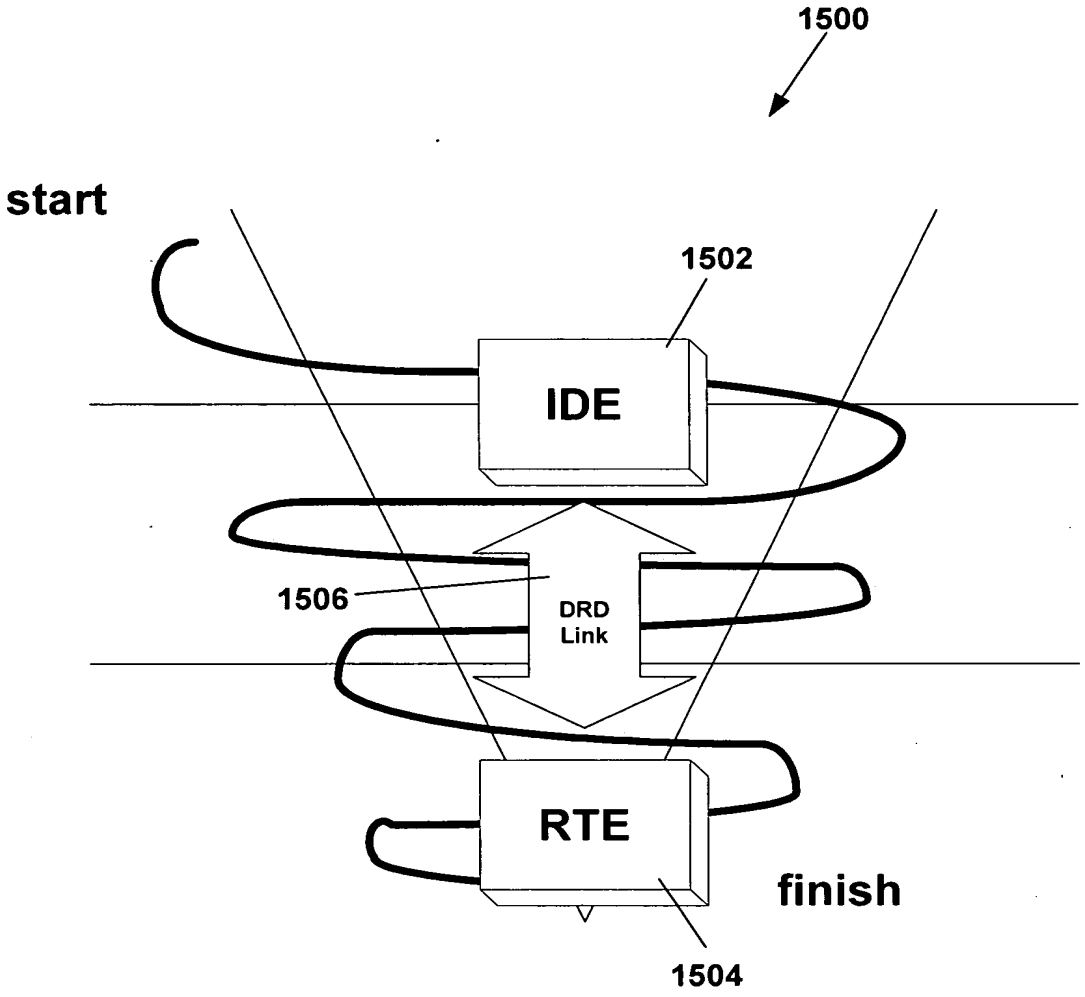


FIG. 16

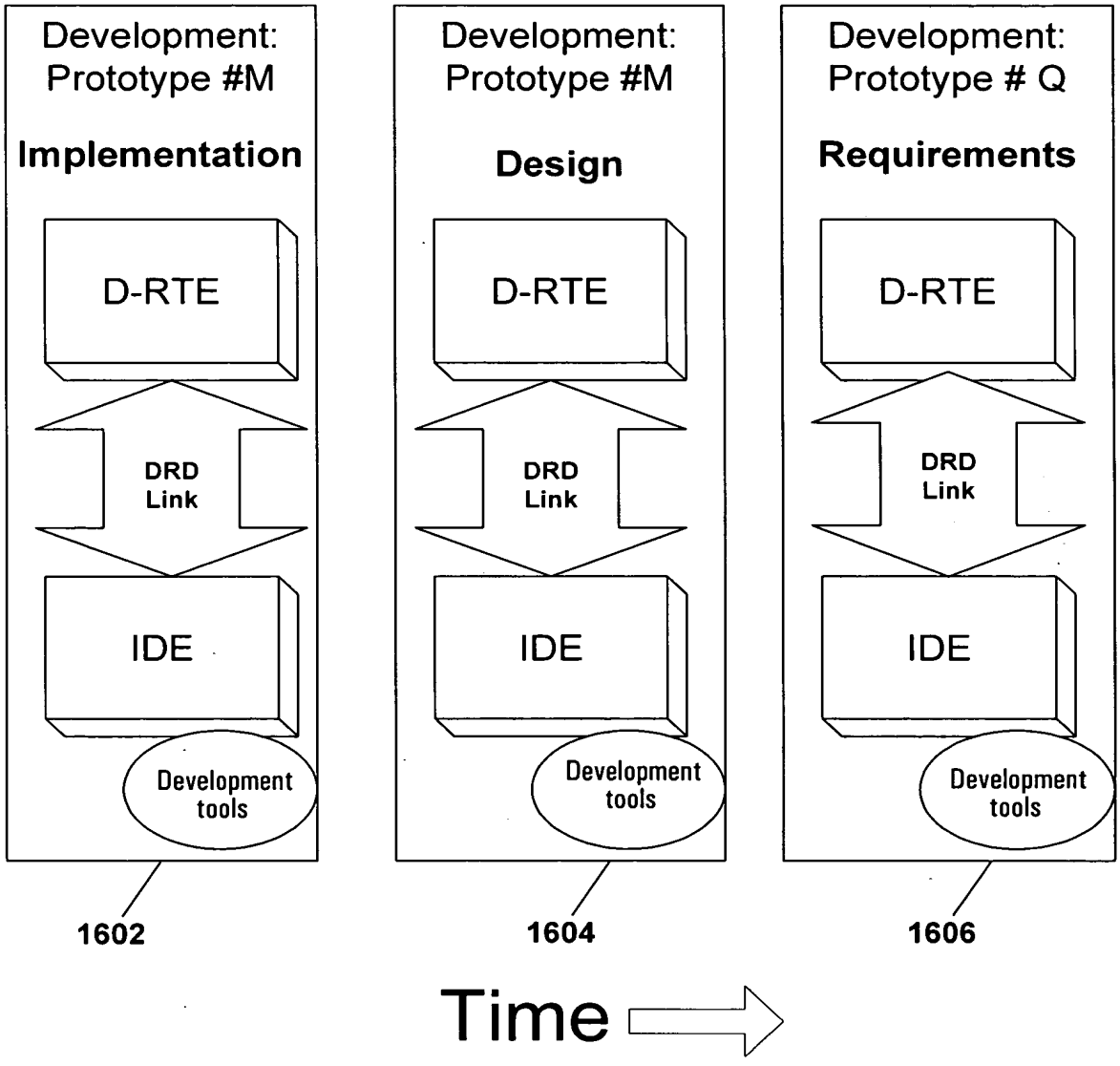
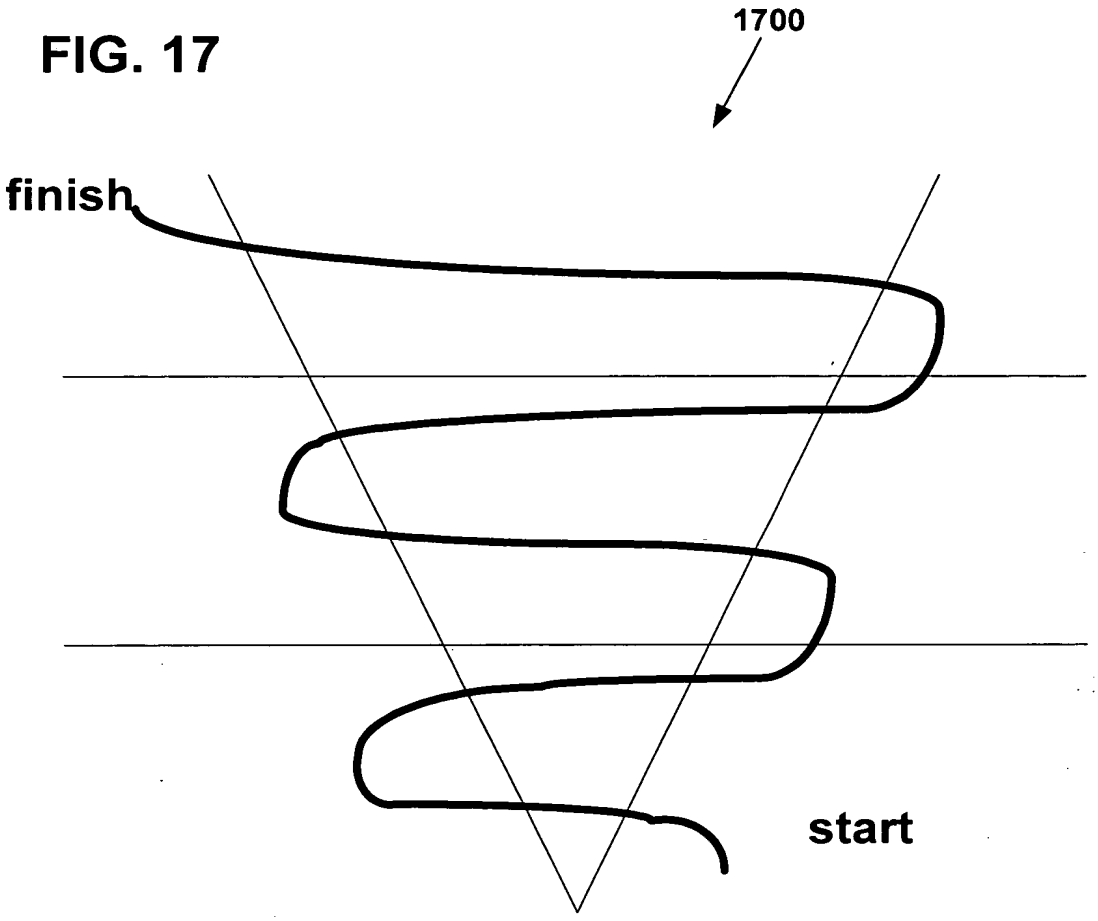

Development: Prototype #M
Implementation
D-RTE
DRD Link
IDE
Development tools
1602
Development: Prototype #M
Design
D-RTE
DRD Link
IDE
Development tools
1604
Development: Prototype # Q
Requirements
D-RTE
DRD Link
IDE
Development tools
1606
Time

FIG. 17

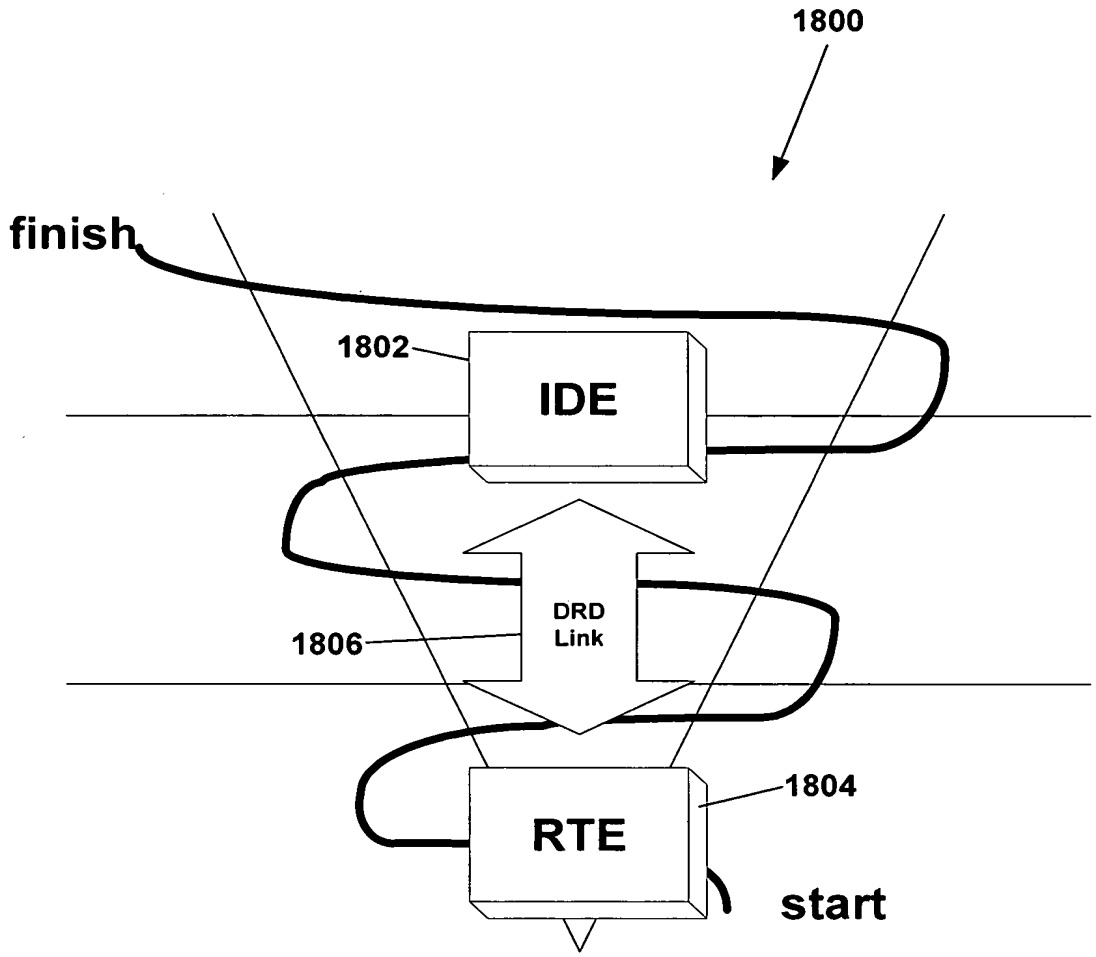


Time follows the spiral

Develop

Integrate, Test, Validate

FIG. 18



Prototype "UP" cycle

Develop

Integrate, Test, Validate

FIG. 19

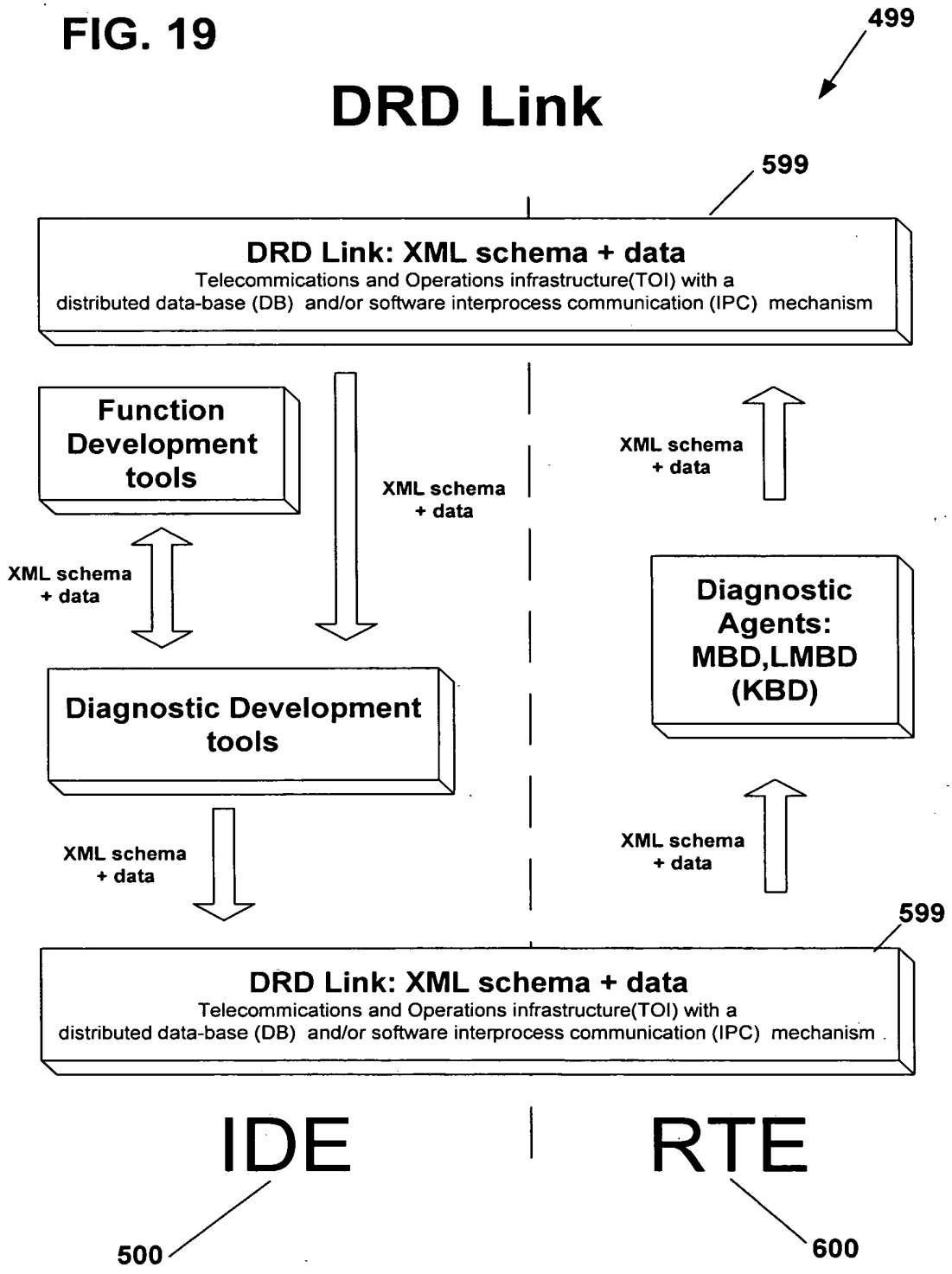

499
DRD Link
599
DRD Link: XML schema + data
Telecommications and Operations infrastructure(TOI) with a distributed data-base (DB) and/or software interprocess communication (IPC) mechanism
Function Development tools
XML schema + data
XML schema + data
XML schema + data
Diagnostic Agents: MBD,LMBD (KBD)
Diagnostic Development tools
XML schema + data
XML schema + data
599
DRD Link: XML schema + data
Telecommications and Operations infrastructure(TOI) with a distributed data-base (DB) and/or software interprocess communication (IPC) mechanism
IDE
RTE
500
600

FIG. 20

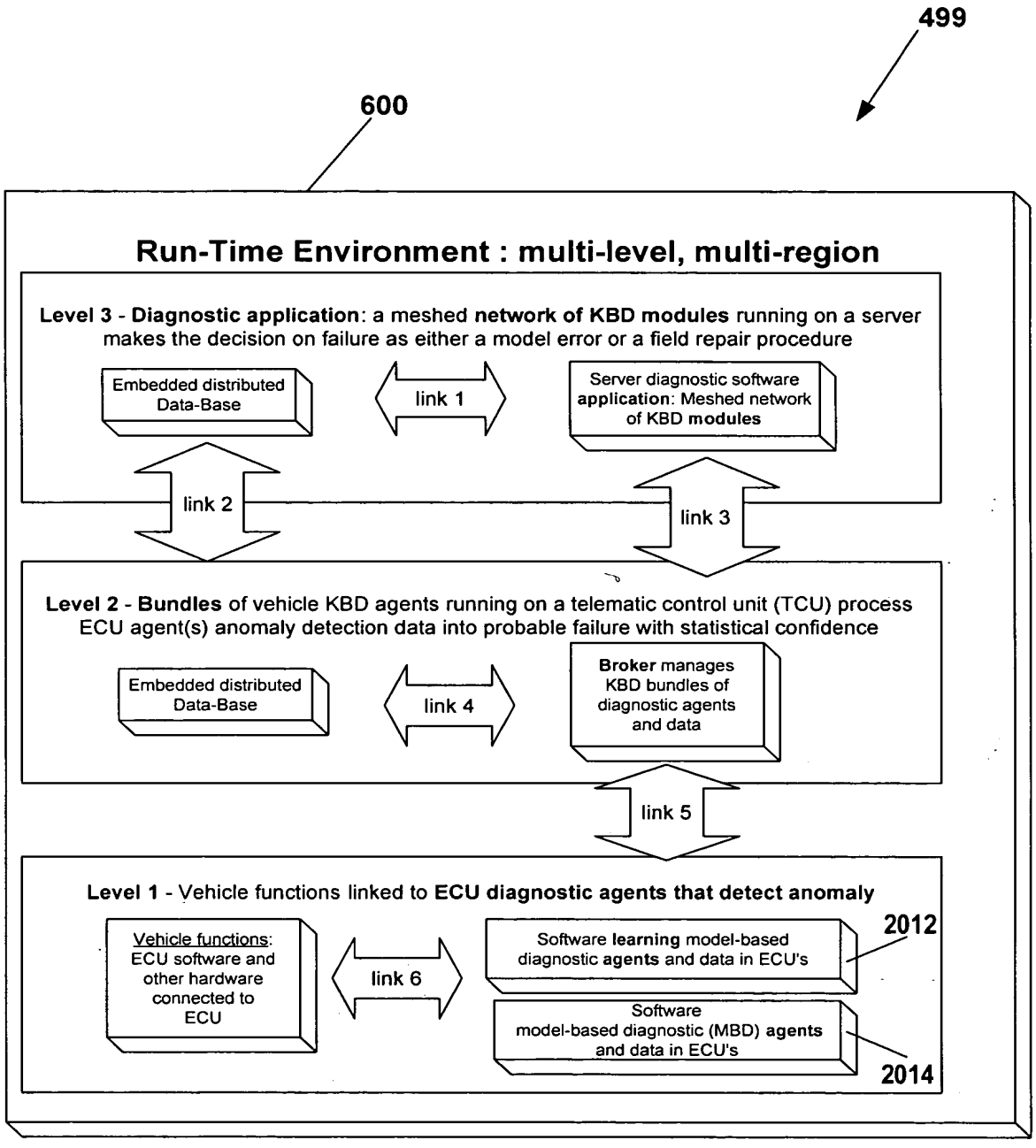
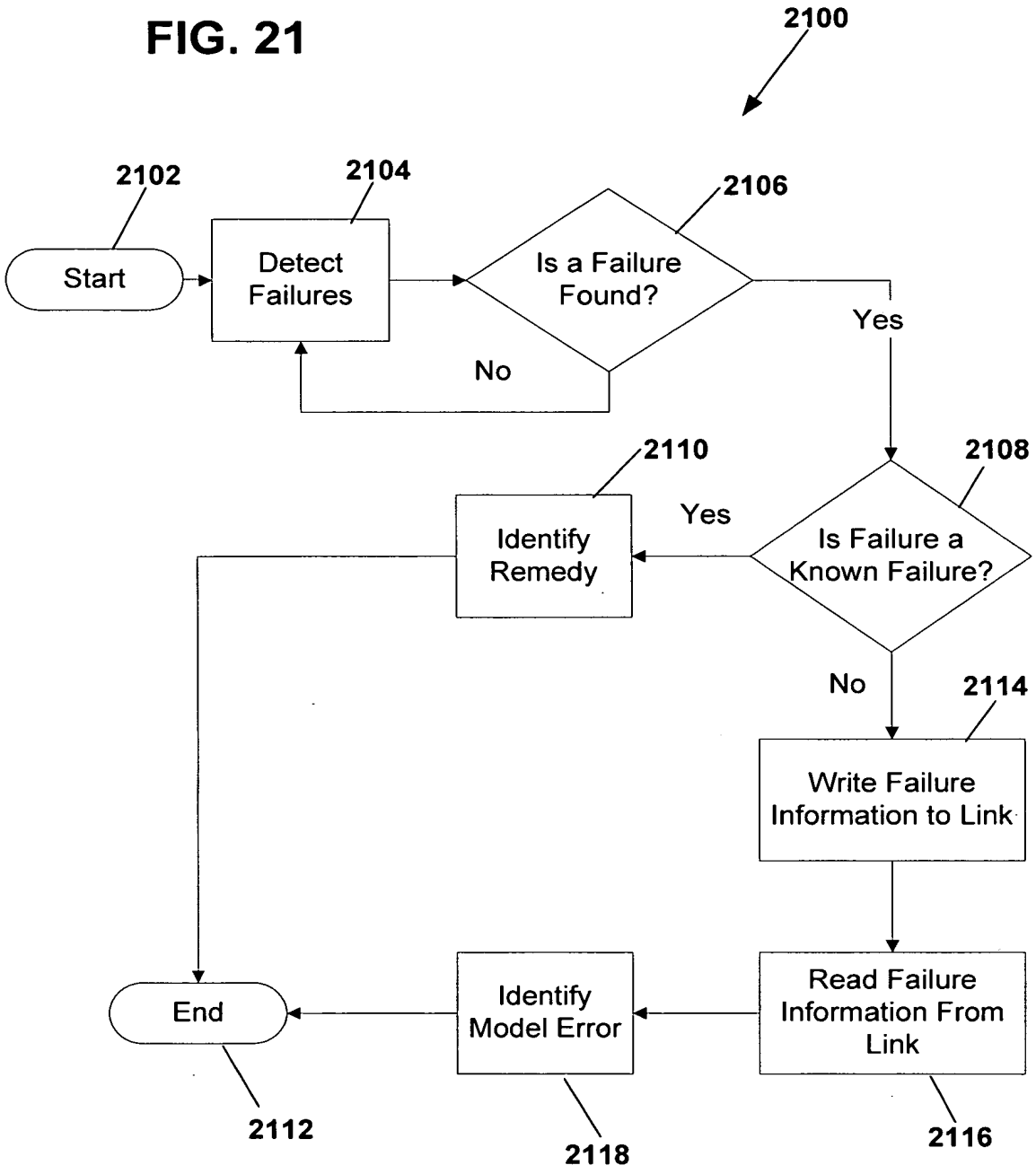

499
600
Run-Time Environment : multi-level, multi-region
Level 3 - Diagnostic application: a meshed network of KBD modules running on a server makes the decision on failure as either a model error or a field repair procedure
Embedded distributed Data-Base
link 1
Server diagnostic software application: Meshed network of KBD modules
link 2
link 3
Level 2 - Bundles of vehicle KBD agents running on a telematic control unit (TCU) process ECU agent(s) anomaly detection data into probable failure with statistical confidence
Embedded distributed Data-Base
link 4
Broker manages KBD bundles of diagnostic agents and data
link 5
Level 1 - Vehicle functions linked to ECU diagnostic agents that detect anomaly
Vehicle functions: ECU software and other hardware connected to ECU
link 6
Software learning model-based diagnostic agents and data in ECU's
2012
Software model-based diagnostic (MBD) agents and data in ECU's
2014

FIG. 21


2100
2102
Start
2104
Detect Failures
2106
Is a Failure Found?
Yes
No
2108
Is Failure a Known Failure?
Yes
2110
Identify Remedy
No
2114
Write Failure Information to Link
Read Failure Information From Link
2116
Identify Model Error
2118
End
2112